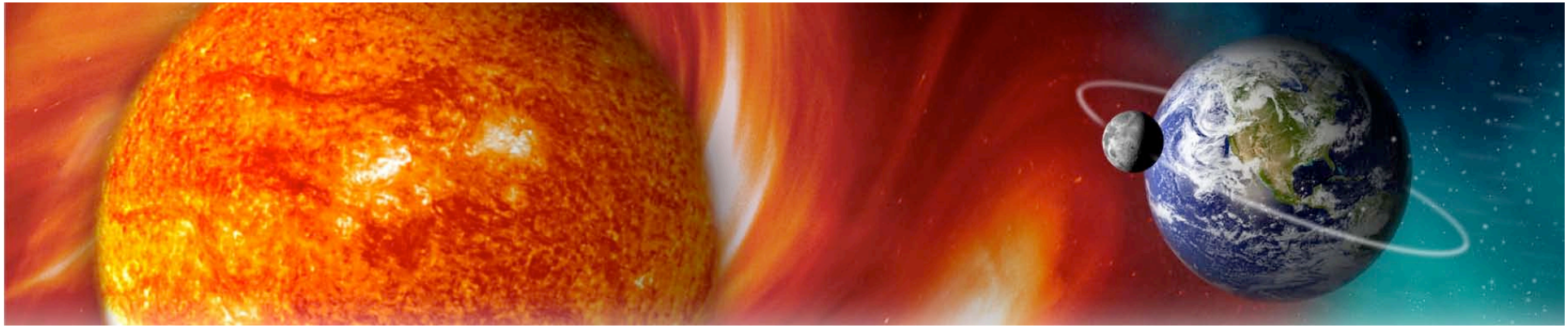


# Program Status & Future: LWS,ILWS,CSW

## 09-20-2007


**Madhulika Guhathakurta**

**Program Scientist, Living with a Star**

**Chair, International Living with a Star**

**Co-Chair, Committee on Space Weather (NSWP)**


- Hinode, STEREO, THEMIS, AIM, Twin-A all successfully launched!!
  - Incredible press coverage on these recent launches and early results
- Space Weather Enterprise Forum during March in Washington, DC
- Solar Cycle 24 Prediction Panel released preliminary prediction in March at NOAA's Space Weather Week
- LWS 2007 workshop "From Sun Towards the Earth" was a big success with 189 members registered.
- Space-Based Ionosphere-Thermosphere Research Conference hosted by Aerospace Corporation in Manhattan Beach, CA 17-19 October, 2007

- Items of interest:
  - "3D Sun" documentary in 3D planetarium at Boston & Liberty Museum (NJ) and others

  http://www.3dsunfilm.com/multimedia.html
  - Libyan eclipse expedition documentary to be released September 20
  - Heliophysics Summer School July 30-August 7, 2007 (see backup charts for details)

  http://www.vsp.ucar.edu/Helio_info.html

# New SMD AA's Priorities

- To advance priorities of Decadal Survey
- To get more from SMD budget (some examples)
  - Control mission costs
  - More frequent small missions
  - International partnerships encouraged
  - Revitalize sub-orbital science program
  - Streamlined processes inside SMD and for grantees
  - Strategic investments in R&A and data analysis across SMD
  - Zero-sum adjustments to achieve the above
- To increase communication with the science community
- To support the Vision for Space Exploration through solid science efforts

# SMEX Opportunity

- Small Explorer AO announcement (NNH07ZDA003O)
  - Release Date: September 28, 2007
  - Notice of Intent: November 16, 2007
  - Proposals Due: January 15, 2008
    - Mission cost $105M, not including launch vehicle
    - Mission of Opportunity allowance $70M
  - Selections anticipated 4 months after proposals due
    - Expecting to select 6-8 Phase A concept studies
  - New experience standard for PI, but only PI
- Two distinct opportunities for Heliophysics:
  - The first opportunity for providing contributions to the Solar Orbiter payload will be a Focused Opportunity for the Solar Orbiter mission (FOSO).
  - The second opportunity for providing contributions to the Solar Orbiter payload will be through the SMEX AO's Mission of Opportunity proposal category.

- http://explorers.gsfc.nasa.gov/042407.html
- http://explorers.larc.nasa.gov/smexacq.html
- POC: Dr. Hashima Hasan; 202-358-0692; hhasan@nasa.gov

# SMEX/Focused Opportunity for Solar Orbiter (FOSO)

- FOSO AO announcement in August, 2007
  - JSTDT task completed (Sept., 2007)
  - Pre-publication report on http://sentinels.gsfc.nasa.gov/
    (Glossy version will be released in early Fall)
  - Final AO targeted NLT October 15, 2007
  - Proposals due 90 days after AO release
    - NASA payload cost for FOSO not to exceed $75 M
    - NASA will provide launch vehicle for Solar Orbiter
  - Selections anticipated 4 months after proposals due
  - FOSO will be part of the SMEX Announcement of Opportunity. All questions related to this opportunity should be addressed to:

- http://explorers.gsfc.nasa.gov/042407.html
- http://explorers.larc.nasa.gov/smexacq.html

- POC: Dr. Hashima Hasan; 202-358-0692; hhasan@nasa.gov


- Senior Advisor for R&A (SARA)
  - Strategic, community informed advice to AA and Divisions on R&A planning and implementation
  - Strategic improvements in communication and processes related to R&A and data analysis across SMD
  - Outreach activities to the community, through science conferences, newsletters, site visits to field centers, universities and other affiliations
  - SARA website and email contact: (sara@nasa.gov)

http://www.science.hq.nasa.gov/research/sara.html

- POC: Dr. Yvonne Pendleton

# ESA NASA Delta Bilateral

- ESA NASA delta bilateral took place on 6-7 of September to discuss ESA's "Cosmic Vision 2015-2025" proposals as well as other on going programs of interest
- NASA committed to provide launch vehicle for the launch of SO in 2015 as well as contribute towards payload
- Two space science missions will be selected
  - medium size mission cost ~300M € (2007€) for launch ~2017
  - flagship class mission cost~650M € (2007€) for launch ~2019

# LWS Status

- SDO continues I&T with instrument deliveries this Fall

Slip in launch date from August 08 to early 09.

- RBSP has selected payload and will complete Phase A this fall'
- Geospace MoO Phase-A reports due in September
- LWS Solar Sentinels and ESA Solar Orbiter JSTDT has been disbanded in anticipation of AO from ESA and NASA
  - Pre publication report now available
  - LoA between ESA/NASA has been signed
  - Ongoing discussion on payload participation
- SMD AA stated goals include advancing priorities of Decadal Survey and he has expressed strong interest in Solar Probe mission
- Two studies have been commisioned at APL, Solar Probe Lite and Solar Sentinels Lite

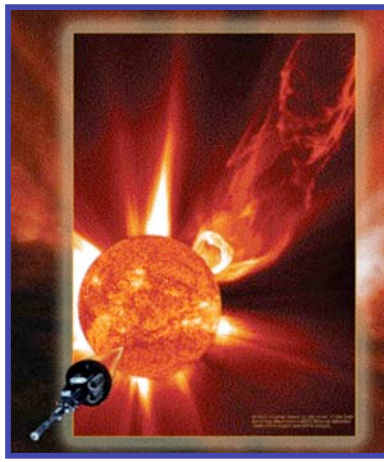
# Solar Probe-Lite Study

Intend to perform a study for a mission which addresses the implied Goals and Priorities of the Decadal survey

Design a mission that can be achieved at a notional budget of about half that estimated by the STDT study for Solar Probe (~700 M)

Candidate trades may include

- Non-Nuclear powered spacecraft,
- Reduced s/c mass,
- Reduced payload capability,
- Review choice of orbit/perihelion, inclination out of the ecliptic and other choices as seen effective.



Study initiated - Fall 2007, Report due in January

Meeting with STDT 24-25 September, 2007, a delta STDT report will be released in Fall, 07

LRD NET 2015

# Focus of Joint SO/SS Mission

**How does the Sun generate the environment of the inner solar system?**

***Primary Objectives:***

1. **Determine the sources, acceleration mechanisms and transport processes of solar energetic particles.**

2. **Determine how coronal mass ejections evolve from the Sun to the inner solar system.**

3. **Determine the origins of solar wind streams and interplanetary magnetic fields.**

**Solar Sentinels NET 2017**

***JSTDT Report finished, September, 2007***

# Missions In Development - Partnership Opportunities

- Solar Probe-Lite  Potential future collaborative opportunity
- Strategic missions MMS and RBSP
- Solar Orbiter Sentinels Joint Science Project
- Partnership in a SMEX mission - Response to FY08 AO
- MOO from SMEX AO - Response to FY08 AO
- Partnership with other agencies is encouraged for IT mission
- The Science Mission Directorate is considering issuing a NASA Research Announcement (NRA) soliciting annually Mission of Opportunity proposals that are not tied to a specific AO.  A more detailed description of this opportunity can be found at the NSPIRES web site, http://nspires.nasaprs.com/


## Selection for FY07

- 148 proposals submitted; 42 selected (success ratio: 1/3.5) for TR&T
- 7 proposals submitted; 1 selected for Strategic Capability
- 2 workshops/summer schools selected

## Changes to NRA for FY08

- Proposal due date changed to late October 2007
- Proposal selection March 2008
- New NRA text posted in mid July
  - Partnership opportunities with Planetary Division and NOAA
  - Read the NRA carefully (NASA will enforce rules strictly)
- TR&T Steering Committee Report available on the web
- New NRA will be out for LWS postdoctoral position this Fall

## Focus Team awardees have been proactive in providing updates to community news sources (Eos)

## TR&T-funded science has resulted in several press releases

## AGU session on system science and TR&T goals

## Town Hall Meeting to solicit community input will be held Fall AGU

## http://lws-trt.gsfc.nasa.gov (improvements underway, provide your feedback)

## NEW email address for TR&T (lws.trt.gsfc.nasa.gov)


| 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|
| The magnetic field topology connecting the photosphere to the corona | Determine the solar origins of the plasma and magnetic flux observed in an ICME (Mikic) | Shock acceleration of SEPs by interplanetay CMEs (Lee) | Predict emergence of solar active regions before they are visible |
| The propagation of the background solar wind flow and superimposed disturbances through the heliosphere | Determine the topology and evolution of the open magnetic field of the Sun connecting the photosphere through the corona to the heliosphere (Zurbuchen) | Mechanism for solar wind heating and acceleration (Miralles) | Understand how flares accelerate particles near the Sun (i.e., through shocks and/or reconnection) and how they contribute to large SEP events |
| The generation and decay of the Earth's radiation belts as a function of geomagnetic and solar wind conditions | Relate solar-energetic particles to their origin at the sun and inner heliosphere (Desai) | Solar wind plasma entry and transport in the magnetosphere (Thomsen) | Effects of ionospheric-magnetospheric plasma redistribution on storms |
| The geophysical conditions favoring the development of low- and mid- latitude scintillations in the Earth's ionosphere | Determine the mechanisms responsible for the formation and loss of new radiation belts in the slot region in response to geo-effective solar wind structures (Liemohn) | Storm effects on global electrodynamics and middle and low latitude ionosphere (Fuller-Rowell) | Investigate the global distribution, sources and effects of large electron density gradients at middle and low latitudes |
| The effects of varying solar EUV radiation on the Earth's ionosphere and atmosphere | Quantify the response of thermospheric density and composition to solar and high latitude forcing (Richmond) | Atmospheric abundance of greenhouse gases and dynamics of the upper atmosphere (joined w. Richmond) | Solar origins of irradiance variations |
| The relationship between solar irradiance and cosmogenic proxies for long term solar activity | Quantify the sensitivity of regional and global climate to solar forcing in the full context of the interactive climate system (Nathan) | | |

# Selected Strategic Capabilities

- 2006 selection
  - Tamas Gombosi, University of Michigan
    The Comprehensive Corona and Heliosphere Model (CCHM)
  - Jon Linker, SAIC
    A Next-Generation Model of the Corona and Solar Wind
  - Joachim Raeder, University of New Hampshire
    Development and Validation of a Comprehensive Magnetosphere Ionosphere Model
  - Aaron Ridley, University of Michigan
    The Community-based Whole Magnetosphere Model

  Nathan Schwadron

  Leonard Strachan
- 2007 selection
  - 3D Model of an Active Region Coronal Magnetic Field (Peter MacNiece)


| | FY04 | FY05 | FY06 ($M) | FY07 | FY08-11 (average per year) |
|---|---|---|---|---|---|
| **"Standard" R&A** | | | | | |
| Heliophysics SR&T, LCAS payloads | $35.7 | $34.7 | $31.8 | $30.7 | $30.9 |
| Theory & Instrument development | | | | | |
| **Other R&DA (w/ Science Teams)** | | | | | |
| **LWS TR&T** | $16.0 | $17.2 | $19.3 | $19.8 | $19.6 |
| **Guest Investigator Program** | $11.4 | $13.7 | $9.1 | $12.1 | $15.0 |
| **Competed Data Programs** | | | | | |
| Virtual Observatories | $0.8 | $1.1 | $1.7 | $2.0 | $4.1 |
| AISRP | $6.3 | $4.2 | $5.6 | $6.8 | $6.8 |
| **Mission Science Teams** | | | | | |
| Currently operating missions | $53.0 | $52.9 | $48.2 | $41.2 | $25 |
| Phase E for missions in development | | | $11 | $42 | $63 |
| **Total of "Other" R&DA programs** | $87.5 | $89.1 | $95 | $124 | $134 |
| **Total Heliophysics Research** | $123.2 | $123.8 | $127 | $154 | $165 |

**Note:** Mission science team budgets represent that portion of a mission's MO&DA budget that go to the 'science tean for science planning, instrument operations and calibration, data processing and distribution, data analysis and research. The 2005 Senior Review provided reasonable fidelity for the currently operating missions. Estimates were made for the missions currently in development [STEREO, Solar B, THEMIS, AIM, SDO, IBEX, etc On average, heliophysics missions spend ~75% of the MODA budget on DA; the range is 48% to 100%.

# LWS Steering Committee Members

*Meeting, Early Fall, Berkeley, CA*

*New Membership*

- *Janet Luhmann, Chair, UC Berkeley*
- *Tamas Gambosi, Ex-Chair, U. Michigan*
- *Merav Opher, George Mason U.*
- *Paul Song, U. Massachusetts at Lowell*
- *George Parks, UC Berkeley*
- *Tony Mannuci, JPL*
- *Mark Rast, CU LASP*
- *Amitava Bhattacharya, UNH*
- *Caspar Amman, NCAR*
- *Art Rihmond, HAO/NCAR*
- *Mike Liehmon, U Michigan*
- *Frank Hill, NSO*
- *Wolfgang Kalkofen, CFA*
- *Martin Laming, NRL*

- *Agency Liasion:*
- *NOAA (Terry Onsager)*
- *NSF (Paul Bellaire)*
- *AFSOR (Dave Byers) *
- *CCMC (Michael Hesse)*
- *Consultant, (Jack Eddy)*

# LWS MOWG Members

*Meeting, Early Fall, Berkeley, CA*

*New Membership*

- *Joe Mazur, Chair, Aerospace Corporation*
- *Glenn Mason, APL*
- *Joesph Davila, GSFC*
- *David Hathaway, MSFC*
- *Janet Luhman, UC Berkeley*
- *Tony Manucci, JPL*
- *Harlan Spence, Boston U.*
- *Don Hassler, SWRI*
- *Judith Lean, NRL*
- *Sarbani Basu, Yale*
- *Neil Murphy, JPL*
- *Stan Solomon, NCAR/UCAR*
- *Rod Heelis, U. Dallas*
- *Kevin Scro, AFSPC*
- *Agency Liasion:*
- *NOAA (Tom Bogdan)*
- *NSF (Bob Robinson)*
- *AFRL (David Cooke)*

# Roadmap Activities

**TENTATIVE MILESTONES:**

- *Roadmap Planning with Heliophysics Subcommittee: Jun and Sept 07*
- *Chairs identified, involved in planning — Jul 07*
- *Community Call for Roadmap Team Nominees: — Aug-Sept 07*
- *Pre-roadmap workshops: — Fall 07*
- *Roadmap Team Appointed: — Oct 07*
- *Kickoff at AGU (Town Hall/mini-team meeting): — Dec 07*
- *Roadmap Team Meeting #1: — Jan 08*
- *Roadmap Team Meeting #2, inc. community workshop: — Mar 08*
- *Roadmap Team Meeting #3: — Jun 08*
- *Roadmap status at HPS: — July 08*
- *Roadmap Overview to HQ: — Aug 08*
- *Red Team Review by HPS — Sep 08*
- *Final Roadmap Draft: — Oct 08*
- *Roadmap Publication: — Dec 08 – Jan 09*

## Spontaneous Generation of Structures and Transients

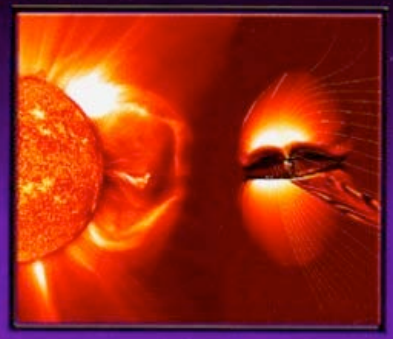
- Flux Ropes-Filaments
- Current Sheets
- Cellular Structures
- Turbulence
- Waves & Emissions

## Creation & Annihilation of Magnetic fields

- Dynamos
- Diffusion
- Dissipation
- Reconnection

# Heliophysics

## A Universal Science



## Explosive Energy Conversions

- Solar (Stellar) Flares
- CMEs
- Substorms
- Bursty Bulk Flows

## Magnetic Coupling

- Non-Local (Non-Contact)
- Flow-Object
- Cross-Scale (Hierarchical)
- Neutral-Plasma
- Dusty Plasmas

## Generation of Penetrating Radiation

- GCRs
- SCRs
- ACRs
- Radiation Belts

## Coupling Sun, heliosphere, galactic environment, and planetary climate

- Dynamos in stars and planets
- Radiative and electromagnetic couplings


*Year 1 Plasma physics of the local cosmos*

*Year 2 Explosive energy conversions and energetic particles*

*Year 3 Explosive energy conversions and energetic particles*

*Three volumes of text will be published for graduate level course in Heliophysics*

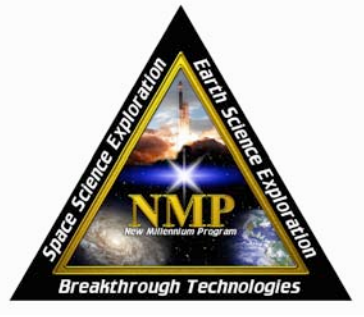
# Heliophysics Program Overview

## Heliophysics Flight Program:


Solar Terrestrial Probes Program


Living with a Star Program


Explorer Program#




New Millennium Technology Program*

## Heliophysics Research:

- Research and Analysis
- Operating Missions / Data / Modeling
- Sounding Rocket Program#
- Guest Investigator Program

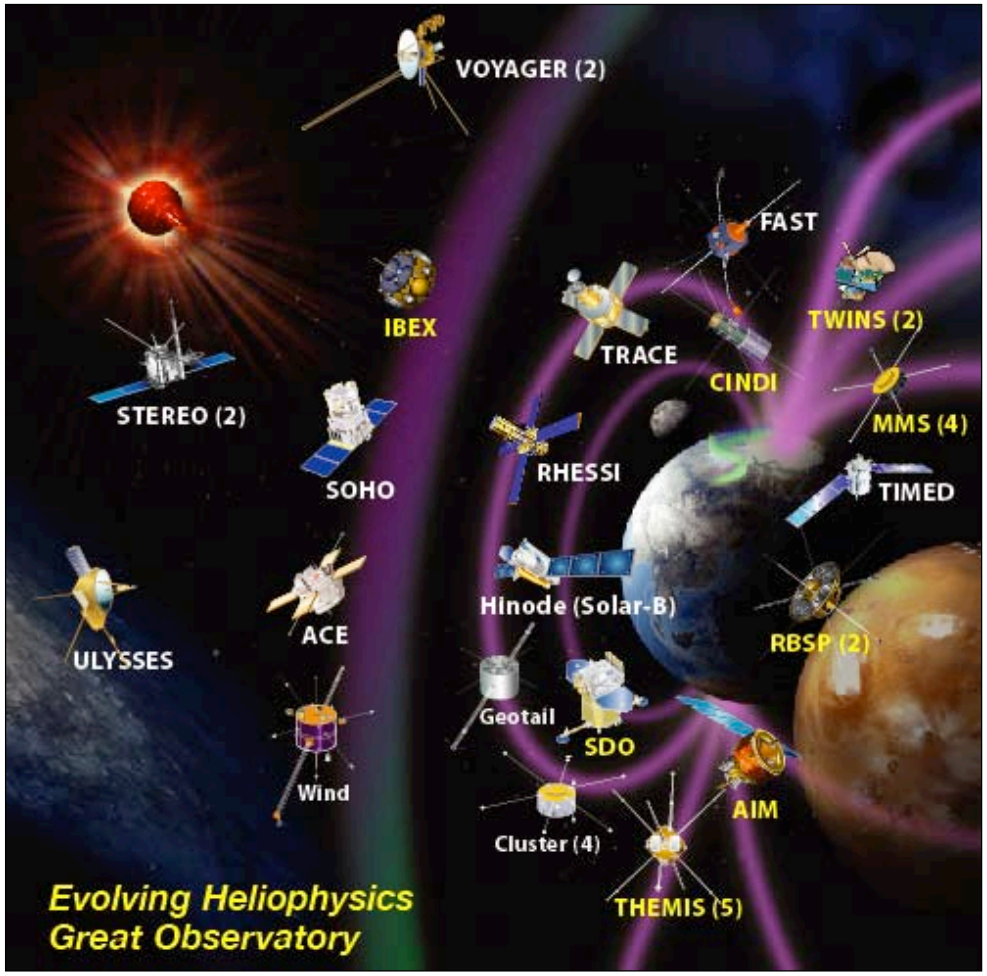
## New Positions

- **At HQ, Solar Physics Discipline scientist**
- **AT GSFC**
  - **Associate Director for PAO**
  - Project Scientist for Solar Orbiter

** Managed for all SMD Scientific Divisions*

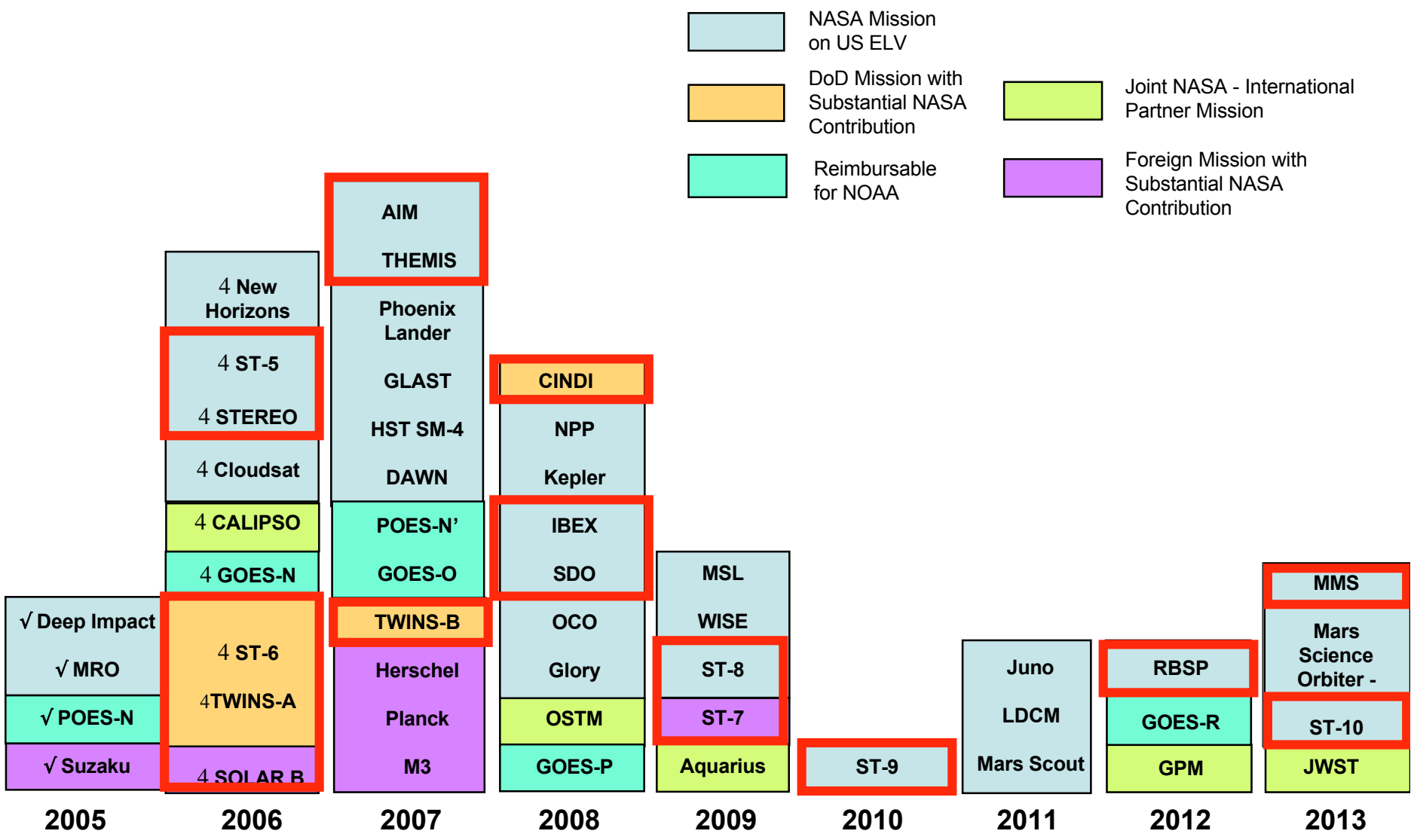
*# Managed for HP and AP*

# Heliophysics Great Observatory




**The Heliophysics Great Observatory** continues to evolve as new spacecraft join and older ones retire or change their operating modes. Missions both in their prime phase and in extended phases provide the variety of observation posts needed to study the range of Sun-solar system connections.

# Heliophysics Plans



# Heliophysics National and International Programs

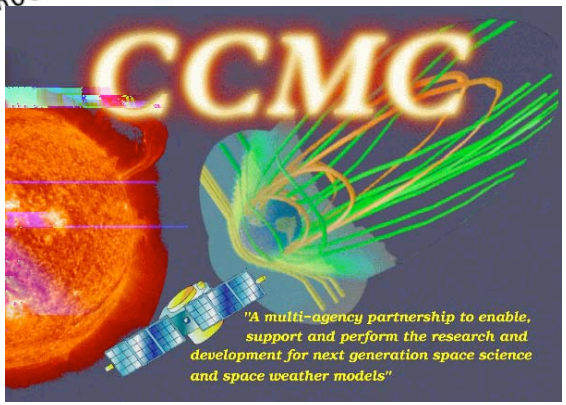
- **The National Space Weather Program (NSWP)** (developing a new Space Weather Strategic and Implementation Plan)
  - http://www.nswp.gov/

- **The Community Coordinated Modeling Center (CCMC)** (workshp on R2O on 15-17 Oct.)
  - http://www.glue.umd.edu/~mhesse/R2O.htm
  - http://ccmc.gsfc.nasa.gov/

- **International Living With a Star (ILWS)**

- **International Heliophysical Year (IHY 2007)**






- NASA is new Chair for ILWS (2007-2008)

**llws.gsfc.nasa.gov**

- ILWS Working Group meeting in Sweden (June 11-13)

Next Meeting, April 19-20 in Prague, ILWS workshop in Brazil, 2009

- Solar Task group (Todd Hoeksema is the chair)
- A new task group targeting Interplanetary/Heliopspheric science will be formed soon.
- Discussion on international cooperation on sub-orbital program being lead by the UK delegate Chris Castelli.
- NASA Administrator will be traveling to India carrying the message of LWS interest in partnership with India especially in the area of IT science and perhaps Solar Sentinels.
- First ILWS Newsletter released in June, next letter due in Fall.

**http://ihy2007.org/ilws/ilws_newsletter_spring2007.html**

- IHY kick-off held at Vienna U.N. COPUOS meeting on February 19, 2007
  - More than 60 nations participated in presenting talks and posters, it was a big success. **Ihy.gsfc.nasa.gov**
- NASA selected 9 proposals out of 29 submitted
- ILWS wants to continue playing a role in enabling nations that have activities that may continue to develop into a space program. IHY has 75 nations with steering committees that have been active.